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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/030,867	04/29/2002	Masanori Kimura	81839.0105	8937

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EXAMINER
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RAO, G NAGESH

ART UNIT	PAPER NUMBER
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1722

DATE MAILED: 12/27/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

<b>Office Action Summary</b>	<b>Application No.</b> 10/030,867	<b>Applicant(s)</b> KIMURA, MASANORI	
	<b>Examiner</b> G. Nagesh Rao	<b>Art Unit</b> 1722	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 05 July 2005.
- 2a) ☒ This action is **FINAL**.                      2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-5 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-5 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
     Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
     Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All    b) ☐ Some \* c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)  | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)                                   | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____  |

***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

1) Claims 4, 1-3, and 5 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kojima (US Patent No. 6,458,202) in view of Ito (JP 01040668) in further view of Hoshi (US Patent No. 6,156,119) in further view of Schupp (US Patent No. 6,562,125).

Kojima 202 discloses a Cz method of pulling a single crystal silicon ingot having a uniform thermal history (See abstract). The power supplied to the side heater is maintained constant throughout the growth of the main body and end cone of the ingot. The power supplied to the bottom heater is gradually increased during the second half of the growth process. The number of defects in the ingots is decreased versus the conventional process. In col. 10 lines 15-35 it is relayed that the bottom heater is used after about 40%-60% or more of the main body has formed. The cooling rate is described as less than 5% variable in the main body of the ingot. In col 6 lines 5-25 (see also Fig 1A) the basics of Cz pulling are described including a crucible charged with raw material, a surrounding side

heater, and a pulling shaft or wire for the withdrawal of the seed crystal from the melt to form the ingot. A steel container encloses the apparatus. Bottom heaters are also provided.

2) However Kojima 202 does not describe utilization percentage of the bottom heater in terms of weight of the ingot withdrawn versus the original raw material weight. Also, heating of the raw material between pulling cycles is not detailed.

Ito 668 discloses a method for growing a semiconductor crystal by the Cz pulling method. A quartz crucible is filled with raw material and heated to form a melt. Side heaters (3) and bottom heaters (4) are used in the heating process. A seed crystal is then contacted with the melt and slowly pulled up to form a single crystal ingot. A chamber (1) surrounds the crucible and heaters. The raw materials is rapidly and effectively melted (abstract) by increasing the temperature uniformly across the crucible (Fig 3 graph where the circles are the present invention).

At the time of the invention it would have been obvious to one with ordinary skill in the art to combine the raw material melting use of the bottom heater (Ito 668) with the growth use of the bottom heater (Kojima 202) because then turn around time between uses of the apparatus would have been reduced and more product could have been made. Ito 668 suggest that the bottom heater allows rapid and effective raw material melting.

In respect to claim 4, it would have been obvious to one of ordinary skill in the art at the time of the present invention to not allow solidification of the remaining melt between batch cycles because this would require additional heat and time to be used in re-melting the remaining raw material with the new raw material added to the crucible for the next batch cycle.

Also, in respect to claim 4, it would have been obvious to one ordinary skill in the art at the time of the present invention that the electric power supplied to the subsidiary heating means be increased when raw material was introduced because the heat required to form a liquid from a solid (i.e. the heat of fusion) would represent a higher heat requirement than simply maintaining a liquid melt remaining in the crucible. This optimization of heat input would have been obvious to one of ordinary skill in the art at the time of the present invention and would have been achieved with only routine optimization. The examiner notes that the Cz method described by includes adding a solid phase raw material to the crucible and melting that raw material to form a liquid melt. Then, a single crystal is pulled from the melt. (The heat of fusion would have been common knowledge to one of ordinary skill in the art; See Sears et al., University Physics, 7<sup>th</sup> Ed., Addison Wesley Pub. Co., pp. 363-365, 1987).

3) However the combined teachings of Kojima 202 and Ito 668 fail to address a crucible with an inner diameter of 28 inches or more.

In a method pertaining to silicon crystal growth, it is taught by Hoshi 119 to grow silicon crystals from a crucible having a diameter of 28 inches (Col 8 Lines 21-37). Now although Hoshi 119 does not explicitly teach the inner diameter is 28 inches, Schupp 125 teaches a heating arrangement for a crystal growth furnace, where it is explicitly taught that the inside diameter of the crucible would need to have an inner diameter of 29 inches, which reads on 28 inches or more (Col 11 Lines 11-23).

It would be obvious to one with ordinary skill in the art at the time of the present invention to incorporate the teachings of Hoshi 119 and especially Schupp 125 with that of the combined teachings of Kojima 202 and Ito 668 because Schupp 125 states that it is crucial for large single crystal growth to have a crucible of a particular size and allow for proper cooling rates to occur.

4) In respect to claim 1, it would have been obvious to one of ordinary skill in the art at the time of the present invention, however, to grow such a Si ingot using a bottom heater powered after 60% (by weight) of the Si ingot has been grown because Kojima 202 suggest using bottom heating after 60% (by length) of the Si

ingot is grown and the length and weight of Si were known to be directly related.

From elementary definitions of density and from geometry of a cylindrical ingot:

$$(L * A) * D = W$$

where:      L = ingot length

A = ingot cross-sectional area

D = Si density (constant at constant growth temperature)

W = Si ingot weight

5) In respect to claim 2, it would have been obvious to one of ordinary skill in the art at the time of the present invention to keep the thermal gradients constant (i.e. uniform) in the ingot throughout all stages of the growth because Kojima 202 specifically suggests this in the first line of the abstract.

6) In respect to claims 3 and 5, it would have been obvious to one of ordinary skill in the art at the time of the present invention to optimize the power values of the main heater and the bottom heater and to control these power values during the growth because Kojima suggest control of the heaters (Col 13 Lines 25-35) and optimization of the power sent to the heaters due to operational parameters including the hot zone design (Col 13 Lines 40-55).

*Response to Arguments*

7) Applicant's arguments filed 7/5/05 have been fully considered but they are not persuasive. Applicant contends that a novel aspect of their invention relied on the fact of having a crucible with an inner diameter of 28 inches or more. However one the prior art presented in the aforementioned rejection begs to differ, as well there is no evidence supported by applicant's specification that the size of the crucible aided in the differentiation of their invention, indicating that crucibles with 12 or 28 inches were essentially equivalent. The crux of the invention pertains to the heating means which the prior art fully shows has been known and obvious to modify based on other analogous prior art. Please see In Re Tarczy-Hornoch 158 USPQ 141.

*Conclusion*

8) Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the



advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to G. Nagesh Rao whose telephone number is (571) 272-2946. The examiner can normally be reached on 9AM-5PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Duane Smith can be reached on (571) 272-1166. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

GNR



**ROBERT KUNEMUND  
PRIMARY EXAMINER**